pass under, and be carried to the shaft in Vine Street. Allowing for any likely greater depth of a former channel, or for any effect the river might have had on the clay, Mr. Barlow considered he would be safe in allowing a minimum thickness of 20ft. of London Clay to exist between the river and the top of the tunnel—a conjecture, the correctness of which has been fully proved in the execution of the tunnel; for not the slightest percolation of water from the river was detected during any part of the work. It is a question, in fact, whether a less depth might not have sufficed. Greater difficulties were apprehended in the making of the two shafts, as the gravel on either side of the river was known to be charged with water—that on the Middlesex side especially. On the north side of the river the ground rises at Tower Hill, and thence towards the City, to a height of about 40ft. above Thames high-water mark; and the London Clay is capped by a thick bed of gravel, the spring at the base of which supplies so many of the City pumps. This gravel, however, does not slope down to the river, but is cut off at the sloping ground. When the shaft on the north side came to be made, it was found, after passing this 14ft. of made ground, that the site of it was exactly on this intermediate hill of clay, and that the gravel which thinned out only a few feet higher had therefore been escaped. The shaft consequently was carried without difficulty through the 14 feet of made ground and 44 feet of London Clay to a depth of 58 feet. On the south side, the gravel, alluvial, and made soils, *a*, were found to be 35 feet thick, and charged with water, which rose and fell with the tide (highest just before low water) in the river, to the extent of 3 feet. By the use of iron-tubing, a passage through has been effected, although with more difficulty, and the shaft carried to a depth of 17 feet in the clay *b*, or a total depth of 52 feet. Between these two points Mr. Barlow laid the tunnel at a slight curve, so as to have a depth in the centre 18 feet greater than at the ends. The shafts have a diameter of 10 feet at top and 8½ feet at bottom. The tunnel is 7 feet in diameter, and is formed by cast-iron tubing in lengths of 1½ feet each, each ring being composed of thin segments with a key piece. An iron shield, devised by Mr. Barlow, was pushed on in advance of the work, and the tubes fixed in as soon as the requisite length of excavation had been completed, and the small space left between the clay and tube filled in at once by concrete. The work was carried on day and night, and advanced without interruption. No subsidence occurred in any part, and a regular and steady progress of 9 feet daily was made. Mr. Barlow, junior, is the engineer of the work, and Mr. Greathead the contractor; and the whole plan and execution of the work does very great credit both to the projector, Mr. Barlow, and to the engineer and contractor. With the exception of a slight leak in the iron tubing of the shaft on the south side, and which has been remedied after but a short delay, not the slightest mishap has occurred in the execution of the work, nor has a single fatal or even serious accident happened to any of the men. Last month the junction between the north and south side was effected, and the error of direction from the two ends was found not to amount to one inch. The passage under the river will be made in an omnibus, by means, probably, of a stationary engine; and lifts on either side will take the passengers up and down. A few minutes will suffice for the journey, and it is hoped that the work may be opened to the public in a few weeks. A remarkable feature of this interesting work has been its small cost. Mr. Barlow's estimate was 16,000*l.*, and it is now tolerably certain that the entire cost will be under 18,000*l.* Another feature has been the rapidity of execution. The shaft on the north side was commenced on the 16th of February last. On the 26th of April the tunnel, which is 1,320 feet long, was commenced, and on the 8th of October the passage under the river was safely effected. Before the public at large was aware that another Thames Tunnel was completed, the old London wonder has been duplicated.

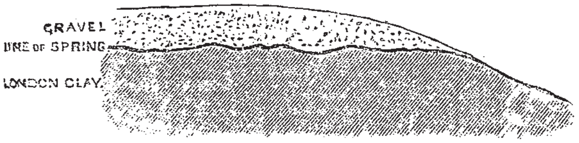

Fig. I

As the object has been chiefly to speak of the geological problem, a section is annexed to show the structure of the ground at this part of the river.

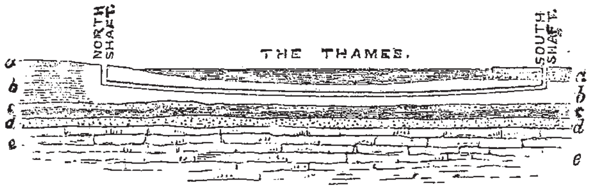

Fig. 2

Very few fossils were found, and these chiefly in the clay of the north shaft. They consist of *Cryptodon angulatum*, *Corbula globosa*, *Pinna affinis*, *Dentalum nitens*, *Fusus*, and column of *Pentencrinite*. In the tunnel pieces of wood pierced by the *Teredo*, and some teeth of Shark, were met with. As the London Clay thickens to the west and north-west, and extends uninterruptedly to Windsor on the one hand and to Watford on the other, covered in places near London by beds of gravel and sand, which never, however, exceed thirty to forty feet in thickness, and rarely exceed fifteen feet, there is thus in this area a formation which lends itself singularly well to the construction of subways and tunnels.

J. Prestwich

THE MAMMALIA OF SWITZERLAND.

Faune des Vertébrés de la Suisse. Par Victor Fatio Dr. Phil. Vol. I. *Histoire Naturelle des Mammifères.* (H. Georg, Genève et Bale, 1869.)

M. FATIO'S book is one which will be valuable to all Swiss naturalists, and to those who take an interest in the productions of the mountainous region of central Europe. It fulfils its function admirably as far as it goes, but, like all works treating of local Faunas or Floras, its general interest is diminished in proportion to the diminution of the area investigated. It has not, for example, the importance or value to a distant reader which such a volume as the "Naturgesch. der Säugethiere Deutschlands und Mitteleuropas" of Blasius possesses; but to local naturalists it will be as useful as are the various volumes on British Zoology published by Mr. Van Voorst, to British zoologists. At the same time, there is always a gain where there is a loss in these matters: what we lose in comprehensiveness we gain in detail; and accordingly in M. Fatio's book we find much that is valuable on account of the great care which he has taken in *personal* investigation; whilst the interest of the whole subject is enhanced by the peculiar and varied conditions of the ice-ploughed Switzerland, to which it relates. Such a valley as that of the Rhone in the Valais presents conditions of climate and vegetation comparable with those of the southern shores washed by the Mediterranean; whilst an extensive region of perpetual snow is within a few hours' walk of this favoured spot. The Alpine valleys of the Grisons, again, present peculiar conditions in their great elevation. M. Fatio finds, however, that the encroachments of man, and his destruction of forest, have a more powerful influence on the distribution of animals than mere circumstances of altitude.

M. Fatio gives the number of mammals inhabiting Switzerland in the wild state—that is, excluding the cat, dog, horse, ass, ox, sheep, and goat—as fifty-eight, or as sixty-one, if the rabbit (which is not indigenous, but has been imported of late years) be reckoned, and the two minute forms, *Sorex pygmæus* and *Mus minutus*, which have been said to occur, but which M. Fatio has not himself succeeded in finding. This list does not include the ibex, the stag, or the *Mus agrarius*, which have become extinct. Some mammals which occur in adjoining countries are remarkable for their absence in Switzerland: thus, the two bats *Rhinolophus clivosus* and *R. Euryale*, which occur in Lombardy, *Mus agrarius*, occurring near the Rhine on the north, and by Como to the south, *Arvicola subterraneus*, also found near the Rhine, and *A. Savii*, found in Lombardy, are not met with in Switzerland.

M. Fatio has increased the catalogue of Swiss mammals, as given by some of his predecessors, by the addition of nine species of bats, two insectivora, and four rodents, one of which is considered a new species altogether.

This new species of M. Fatio, is a little black mouse, very much like the common house mouse (*Mus musculus*), but having a very dark black-coloured fur; the two presenting much the same contrast as do the *Mus rattus* and *Mus Alexandrinus*, which M. Fatio agrees with M. Arthur de l'Isle in considering one and the same species. The new mouse, however, which is called *Mus Poschiavinus*, from the locality where it was observed, presents more important differences when compared with *Mus musculus* than those of colour and proportion only, The palatine ridges in *M. Poschiavinus* are *four* in number, in place of *five* in the common species, and the anterior simple ridges are of a different form.

The strange thing about this little black mouse, which is found at Poschiavo in the Grisons, is that it lives on tobacco. It was first noticed in a tobacco-factory, and was found to make great ravages among the stores of the nicotian weed. When first caught, M. Fatio thought he had possibly got hold of young specimens of the black rat, but subsequently he obtained specimens bearing evident signs of maturity. It does not appear to have suggested itself to M. Fatio's mind, that his *Mus Poschiavinus* may be only a sample of the deleterious effect of indulgence in the noxious herb to which these rodents are addicted. What if this new black mouse is but a stunted race of the black rat? It would furnish an invaluable argument to the anti-tobacconists.

A very pretty coloured plate, representing two Poschiavinian mice helping themselves to cigars, illustrates the description of this species. It is not a little remarkable that an animal should normally feed on tobacco. Monkeys, as is well known to the frequenters of menageries, are exceedingly fond of the end of a cigar, and an elephant has been seen gravely to accept such an offering; but one would have supposed that the amount of nicotine in a pinch of snuff was enough to make a mouse unwell. The indifference of these mice to the toxic action of tobacco, calls to mind the similar indifference on the part of pigeons (rodents are like birds in many things) to the toxic action of opium in the largest doses, as lately noticed by Dr. Weir Michell.

Among the rarer and more interesting forms noticed by M. Fatio as still existing, or as having existed—for he notices the contents of the quaternary deposits in Switzerland—are the Bear (*Ursus arctos*), the Wolf (*Canis lupus*), the Wild Cat (*Felis catus*), the Lynx (*Felis lynx*), the Bouquetin or Ibex (*Capra ibex*), the Chamois (*Capella rufricapra*), and the Stag (*Cervus elaphus*). With regard to this last, it appears that, eighty years since, very fine specimens inhabited the Swiss valleys; now it only appears when driven from the German forests lying to the north; its remains are found in quaternary deposits. The fallow-deer is represented neither in the present nor in the quaternary fauna; the Roebuck, or Chevreuil, is the only cervine species still inhabiting the country. Wolves, lynxes, and wild cats are not uncommon in the forests of the Jura; but the lynx has not been found in the quaternary deposits, which is noteworthy, since Dr. Ransom, of Nottingham, has found it in England in such beds.

The bear is commonest in the Grisons; every year there is some bear-hunting to be done in these wild and elevated valleys. The ibex, though no longer found in the Swiss Alps, occurs in the immediately adjacent territory of Lombardy; where, however, it is now strictly preserved. The ibex of the Alps, of the Pyrenees, of Siberia, and of Crete, each have very distinctive characters, in the direction and length of their horns, but are hardly to be considered as distinct species. Some naturalists, however, distinguish a second species in Spain, as *Ægyceros Hispanicus*, occurring farther south than the so-called *Ægyceros Pyrenaicus*. The domesticated *Capra hircus*, has no doubt largely taken the place of the indigenous ibex; natural hybrids between the two are not uncommon. The industrious Swiss have sometimes exhibited to curious tourists an eccentric specimen of the common goat as a living ibex. M. Fatio mentions such an instance, which may put naturalist travellers on their guard. A specimen presented by the King of Italy may be seen in the Zoological Gardens, Regent's Park. The chamois are still very numerous in Switzerland, though the large herds of eighty and a hundred, which used to be seen in past times, are not now met with. A certain amount of care is exercised now in regard to the time of hunting, and the animals are allowed to breed in security, so that they are on the increase in localities where they had become scarce. M. Fatio mentions an old hunter who boasted of having killed as many as 3,000 chamois.

The Alpine marmot, which is so common and so well known to Alpine tourists, is not the mammal which attains the highest elevation of habitat in Switzerland; another little rodent, the *Arvicola nivalis*, has that distinguished honour, living at a greater altitude than any other European mammal.

Both this species and the marmot live among the oases of rock and herbage which stand out amidst the vast masses of mountain ice. The Bobac marmot does not occur in Switzerland, being confined to the north-eastern districts of Europe. The Alpine marmot inhabits the Carpathians and the Pyrenees, as well as the Alps.

M. Fatio's book is illustrated by eight plates, giving figures of new or rare forms. Synoptical tables of the families and genera are also given, so as to enable the least experienced naturalist to determine with facility the species which may come before him. A second volume, to include the reptiles, batrachia, and fishes, and a third, treating of the birds, are soon to be brought out by the same careful and enthusiastic observer.

E. RAY LANKESTER

OUR BOOK SHELF

Mining Geology.—*Die Lagerstätten der nutzbaren Mineralien.* Von Johann Grimm. (Prague: J. G. Calve).

THE author of this volume is an Oberbergrath, and also Director of the Imperial Mining Academy at Pribram. During the last seventeen years he has from time to time published notices of the mineral veins and other mining features of Transylvania, Hungary, and Bohemia; and he now presents to the public a general treatise or handbook of the useful minerals. His experience has not been wide enough to enable him to write a book that fully justifies the title he has chosen for it, and his acquaintance with the literature of his subject appears to be limited to the German language. But the book is the work of a practical man, is well arranged, and contains much useful information. Fresh illustrations even of well-known facts are always interesting, more especially when they carry with them some little features that are novel. In this respect, mining geologists in this country will find it worth their while to hear what Herr Grimm has to say of the minerals, veins, beds, faults, and other mining features of various parts of the Austrian Empire. A. G.

Practical Astronomy and Geodesy.—*Geographische Ortsbestimmungen mit Hülfstafeln.* 4to. pp. 88. By W. Valentiner. (Leipzig: 1869. London: Williams and Norgate.)

THE purpose of the author was to afford the astronomers engaged in the great European Triangulation tables for facilitating the reduction of the observations made for finding azimuths and the altitude of the pole. The work is, however, of more than a transient merit, for it will probably be of much assistance to our Indian officers engaged in the great trigonometrical survey of the Peninsula, and some of the tabular matter might henceforth in a modified form be well included in works on higher geodetic operations generally.

The author, by differentiating some of the fundamental equations which connect the latitude of a place with the altitude of a heavenly body above the horizon, its declination, azimuth, hour-angle, and parallactic angle, shows the influence which the errors in the observed quantities exert upon those that are dependent upon them, and comes to the conclusion that circumpolar stars are best adapted for azimuth determinations. He especially recommends to the observers engaged in the arc measurement the star *Ursæ minoris*, which is seen at all hours with telescopes of about $1\frac{3}{4}$ to 2 inches aperture, and the succeeding formulæ have been calculated with special reference to that star. Thus, taking the fundamental equations, in which z, a, δ, t, ϕ, are the well-known symbols for zenith distance, azimuth, declination, hour-angle, and latitude respectively, the author obtains by division, transformation, and expansion, and substituting p for $90° - \delta$, the following elegant expression for the azimuth:—

$$a = p \sin t \text{ see } \phi + M \sin 2t + N$$

The values of M and N being essentially dependent on t and ϕ alone, admit of tabulation with t and ϕ as arguments, and are given by the author for all latitudes between 36° north and 64°, this being the extent of the arc to be measured; t is given from ten to ten minutes.

The formulæ for the altitude of the pole are discussed very carefully on the same principles. The whole is the result of much labour, and M. Valentiner well deserves the sincere gratitude of the numerous computers whose work he has facilitated. B. L.

Manual of Physics.—*Lehrbuch der Physik, einschliesslich der Physik der Luft (Meteorologie), des Himmels (Himmelkunde), und der Erde (Physikalische Geographie).* Von Dr. Paul Reis. Erste Hälfte, pp. 256. (Leipzig: Quandt und Händel. 1870.)

THIS is the first half of a treatise on Elementary Physics from a highly scientific point of view. Dr. Reis considers that the principle of the conservation of force—as he puts it, "Die energie des Weltalls ist constant" (the energy of the universe is constant)—is at the root of all science, and that it is possible to deduce a large part of physics as a mathematical consequence of this principle. We confess to a little doubt whether it is advisable to introduce it in this form in the first instance in an elementary text-book. The attempt is one, however, that must be made no doubt at an early date, in some form or other.

The first instalment of the work contains an introduction of considerable length on the elementary ideas at the root of physics—such as space, time, matter, rest and motion, matter and force—the forces which appear in all phenomena, molecular, chemical, cohesion, adhesion, gravitation—and the fundamental axioms of physics, which he gives us in six statements not materially differing from Newton's three laws. After 80 pages out of 500 have been occupied in this way, we confess that we doubt whether sufficient room is left for the adequate treatment of the enormous range of subjects which is to follow. The mechanics of solids, fluids, and gases occupy the author for the next 100 pages, and the last 70 of this first part are given to wave-motions and acoustics.

The book is carefully worked, and full of examples for the student. The new form in which familiar things are presented makes it interesting to those who are acquainted with the subjects it treats of. It appears to be conscientiously brought up to the science of the present day, but we must reserve our opinion as to the question whether it accomplishes the task it proposes to itself, or whether, in its present form, it will be valuable as a text-book till the appearance of the second half, which completes the work. It claims to possess a plan of its own, and it must be estimated according to that claim.

W. J.

Meteorology.—*Die Theorie und Das allgemeine geographische System der Winde.* (Göttingen, 1869. London: Williams and Norgate.)

THE author is an opponent of Dove's school of meteorologists. The facts discussed by him are well known, and far more concisely stated in any recent work on meteorology. The theories founded by the author on those facts are too fanciful, and of his speculations—founded on no facts at all—the least said about them the better.